

Version with Markings to Show Changes

1. [Twice Amended] A single element piezoelectric sensor for detecting acoustic seismic data comprising:

a continuous uninterrupted piezoelectric film forming a single piezoelectric element placed on a surface of a relatively incompressible substrate, wherein the piezoelectric film adjacent the relatively incompressible substrate generates an electrical signal substantially sensitive to compression of the piezoelectric film only;

a plurality of areas of relatively compressible substrate formed in the surface of the relatively incompressible substrate adjacent areas within the continuous uninterrupted piezoelectric film, wherein the area plurality of areas within the continuous uninterrupted piezoelectric film adjacent the areas of relatively compressible substrate generate an electrical signal substantially sensitive to stretching of the piezoelectric film adjacent the relatively compressible substrate [responsive to bending strain and compression strain forming a plurality of discrete areas of increased sensitivity in the stretch direction and thickness dimension in the piezoelectric film adjacent the relatively compressible substrate to impinging acoustic pressure waves]; and a single electrical output from the single piece of piezoelectric film [plurality of discrete areas of increased sensitivity].

2. [Twice Amended] The piezoelectric sensor of claim 1 further comprising:  
a plurality of areas of relatively compressible substrate formed in the surface of the relatively incompressible substrate forming a continuous line array of discrete areas

4 of increased sensitivity in the piezoelectric film to impinging acoustic pressure waves  
5 a beam pattern for the sensor determined by the relationship between the shapes and  
6 configuration of the areas relatively incompressible substrate and the areas of  
7 relatively compressible substrate adjacent the single piece of piezoelectric film.

1 3. [Twice Amended] The piezoelectric sensor of claim [2] 1, further comprising:  
2 a two-dimensional array of areas of relatively compressible substrate formed in the  
3 surface of the relatively incompressible substrate forming a two-dimensional  
4 continuous line array of areas of increased sensitivity in the piezoelectric film to  
5 impinging acoustic pressure waves.

1 4. [Previously Amended] The piezoelectric sensor of claim 3, further comprising:  
2 the two-dimensional continuous line array of areas of increased sensitivity are formed  
3 into a three-dimensional shape to form a three-dimensional continuous line array of  
4 areas of increased sensitivity to impinging acoustic pressure waves in the  
5 piezoelectric film.

1 9. [Previously Amended] The piezoelectric sensor of claim 2 further comprising:  
2 variation in at least one of a size and location of the areas of increased sensitivity to  
3 shape the beam pattern of the piezoelectric continuous line array.

1 10. [Previously Amended] The piezoelectric sensor of claim 2 further comprising:

variation in at least one of a size and location of the areas of increased sensitivity to shape the spectral response of the piezoelectric continuous line array.

11. [Previously Amended] The piezoelectric sensor of claim 2 further comprising:  
variation in a ratio of the total surface area of the areas of increased sensitivity to the total surface area of the relatively incompressible substrate to shape the beam pattern of the piezoelectric continuous line array.

12. [Previously Amended] The piezoelectric sensor of claim 2 further comprising:  
variation in a ratio of the total surface area of the areas of increased sensitivity to the total surface area of the relatively incompressible substrate are varied to determine the spectral response of the piezoelectric continuous line array.

9. [Twice Amended] The piezoelectric sensor of claim 1 [3] further comprising:  
[a shape of the continuous line array formed to determine a beam pattern of the continuous line array] wherein the piezoelectric film adjacent the areas of relatively compressible substrate generate an electrical signal substantially larger than the piezoelectric film adjacent the areas of relatively incompressible substrate.

11. [Previously Amended] The piezoelectric sensor of claim 3 further comprising:  
a shape of the continuous line array formed to determine the spectral response of the continuous line array.

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2 24. (new) A method for detecting acoustic seismic data on a single element piezoelectric  
3 sensor comprising:

4 placing a continuous piece of uninterrupted piezoelectric film forming a single  
5 piezoelectric element on a surface of a relatively incompressible substrate, wherein  
6 the piezoelectric film adjacent the relatively incompressible substrate generates an  
7 electrical signal substantially sensitive to compression of the piezoelectric film only;

8 forming a plurality of areas of relatively compressible substrate formed in the surface  
9 of the relatively incompressible substrate adjacent areas within the continuous  
10 uninterrupted piezoelectric film, wherein the area plurality of areas within the  
11 continuous uninterrupted piezoelectric film adjacent the areas of relatively  
12 compressible substrate generate an electrical signal substantially sensitive to  
13 stretching of the piezoelectric film adjacent the relatively compressible substrate; and  
14 connecting a single electrical output from the single piece of piezoelectric film  
15 forming the plurality of discrete areas of increased sensitivity.

1 25. [new] The method of claim 24 further comprising:

2 forming a beam pattern for the sensor by adjusting the relationship between the  
3 shapes and configuration of the areas relatively incompressible substrate and the areas  
4 of relatively compressible substrate adjacent the single piece of piezoelectric film.

1 26. [new] The method of claim 24, further comprising:

forming a two-dimensional array of areas of relatively compressible substrate formed in the surface of the relatively incompressible substrate to create a two-dimensional continuous line array of areas of increased sensitivity in the piezoelectric film to impinging acoustic pressure waves.

27. [new] The method of claim 26, further comprising:

forming the two-dimensional continuous line array of areas of increased sensitivity into a three-dimensional shape to form a three-dimensional continuous line array of areas of increased sensitivity to impinging acoustic pressure waves in the piezoelectric film.

32. [new] The method of claim 25 further comprising:

varying a size or location of an area of increased sensitivity to shape the beam pattern of the piezoelectric continuous line array.

33. [new] The method of claim 25 further comprising:

varying a size or location of an area of increased sensitivity to shape the spectral response of the piezoelectric continuous line array.

34. [new] The method of claim 25 further comprising:

varying a ratio of the total surface area of the areas of increased sensitivity to the total surface area of the relatively incompressible substrate to shape the beam pattern of the piezoelectric continuous line array.

1        35.    [new] The method of claim 25 further comprising:

2                variation in a ratio of the total surface area of the areas of increased sensitivity to the  
3                total surface area of the relatively incompressible substrate are varied to determine the  
4                spectral response of the piezoelectric continuous line array.

1        32.    [new] The method of claim 25 further comprising:

2                wherein the piezoelectric film adjacent the areas of relatively compressible substrate  
3                generate an electrical signal substantially larger than the piezoelectric film adjacent  
4                the areas of relatively incompressible substrate.

1        34.    [new] The method of claim 26 further comprising:

2                shaping of the areas forming the continuous line array to determine the spectral  
3                response of the continuous line array.